# Monitoring Completed Navigation Projects (MCNP) Program

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Funding Source
O&M

18-19 October 2004 (FY05)
Fort Belvoir, Virginia

# Engineer Regulation ER 1110-2-8151

## Engineering and Design

# MONITORING COMPLETED NAVIGATION PROJECTS

**31 July 1997**

- **Deep- and Shallow-Draft Navigation Projects Located in the Coastal Zone, Estuaries, Rivers, Lakes, and Reservoirs**
- **Completed Navigation Projects Operated and Maintained by the Corps of Engineers**

# MNCP Monitoring Sites


US Army Corps of Engineers

Coastal and Hydraulics Laboratory - ERDC

# FY 04 MCNP Projects

1. Periodic Inspections, Ofu Harbor, American Samoa
2. Tedious Creek, MD (completed)
3. Upper MS River Training Structures
4. Aguadilla Harbor, Puerto Rico (completed)
5. Houston Ship Channel, TX
6. Pocket Wave Absorber, Great Lakes
7. Bendway Weirs, Greenville Bridge Reach, MS
8. Program Management and Technology Transfer

# Projects Completed 30 September 2004

1. Tedious Creek, MD

2. Aguadilla Harbor, Puerto Rico

# Tedious Creek, MD

## Monitoring Study

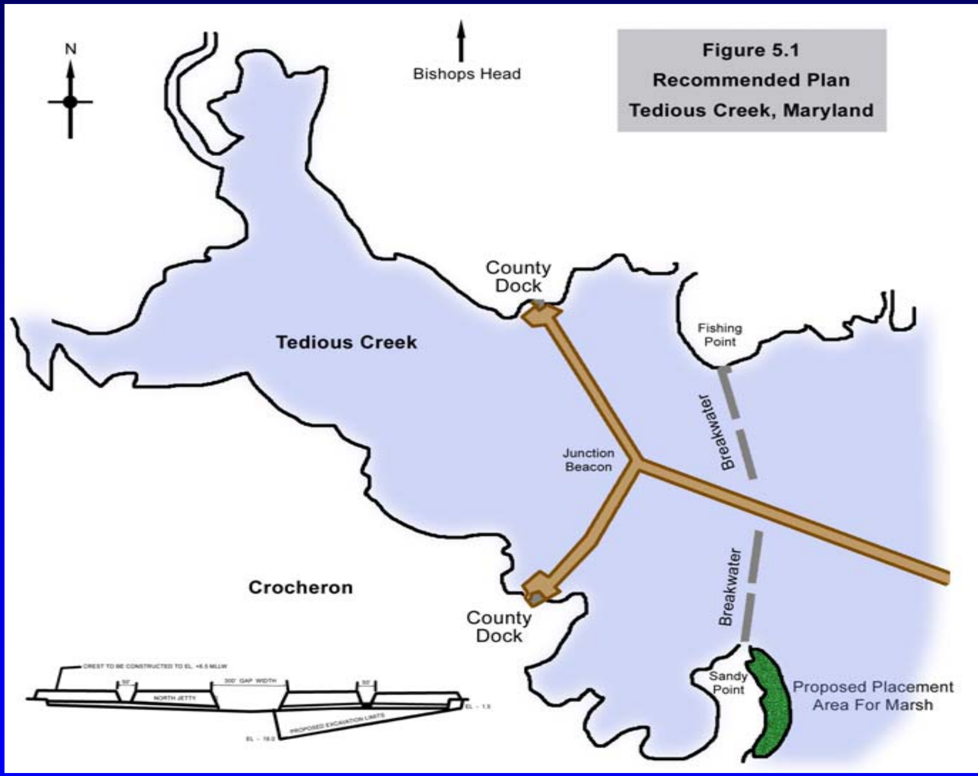
Wave measurements

Tidal elevations/currents

Sedimentation processes

Wetland accretion/erosion

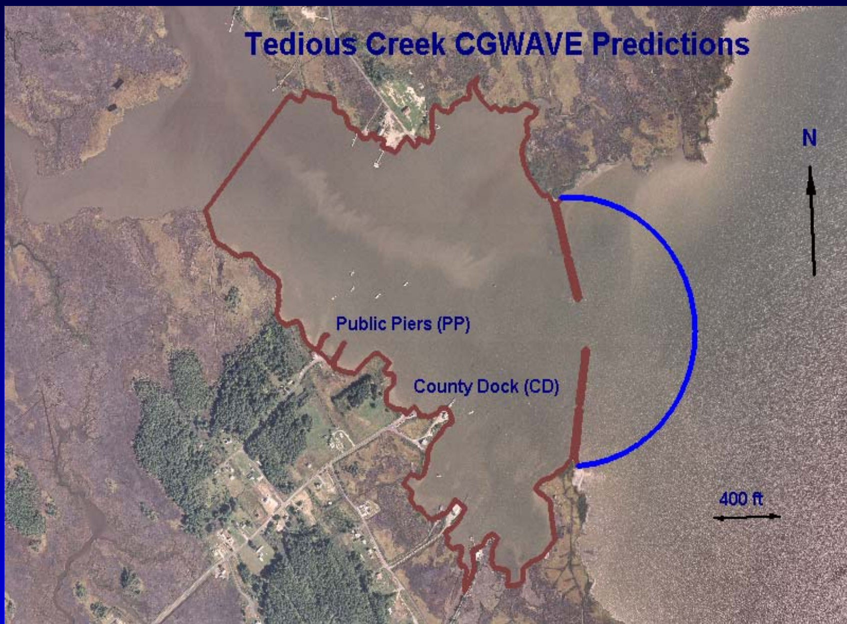
Structure stability

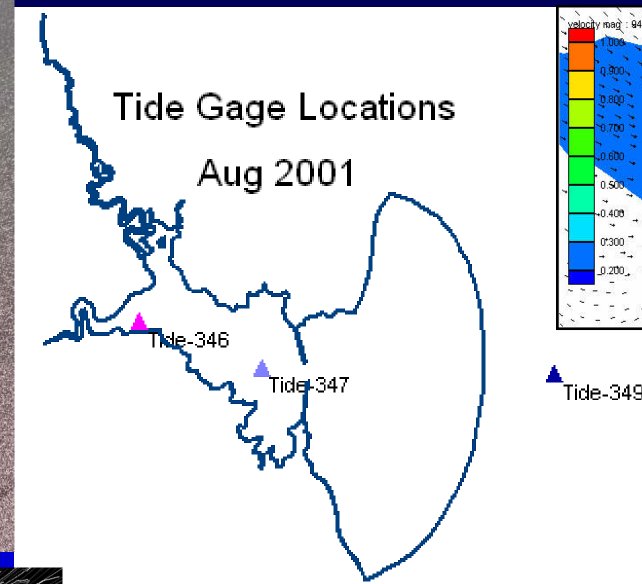


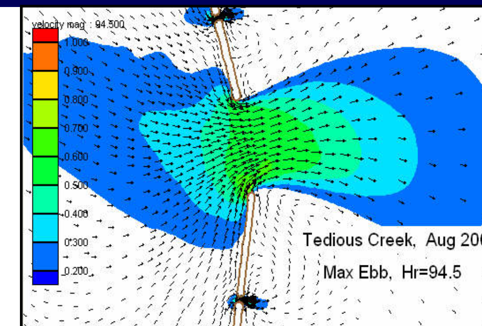

PI: ERDC – Barbara Donnell

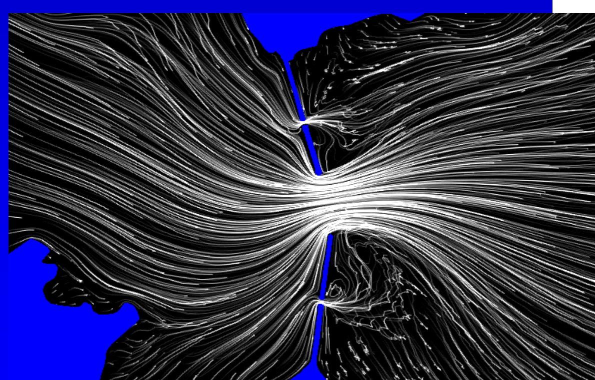
NAB – Karen Nook

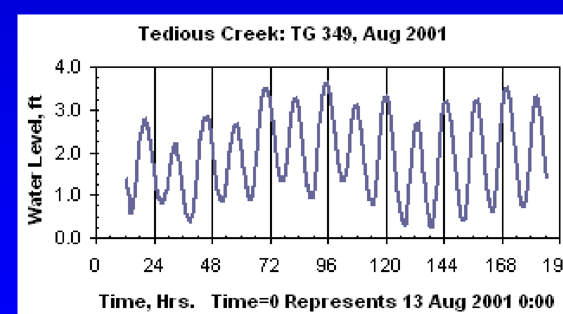
# Tedious Creek, MD





# Aguadilla Harbor, Puerto Rico

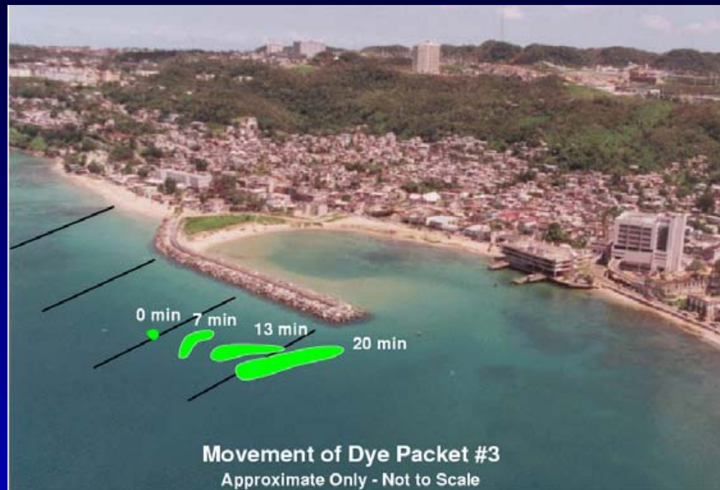
<u>Monitoring Study</u>

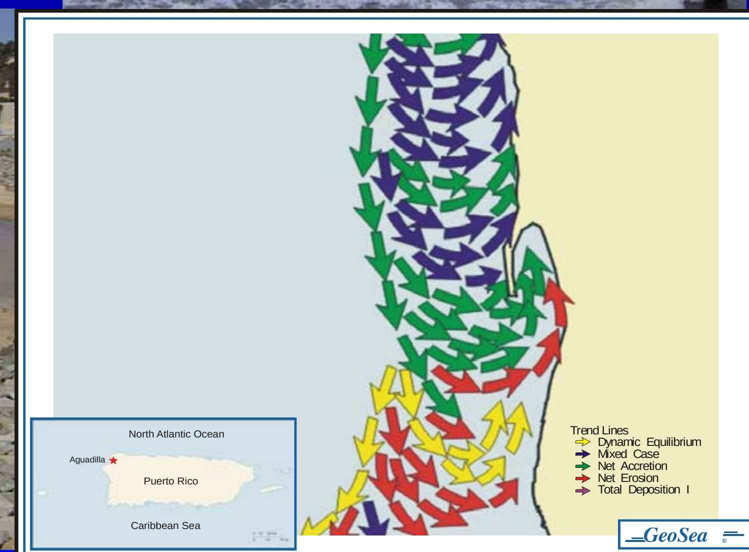
- Wave measurements
- Beach/hydrographic surveys
- Sand transport through breakwater
- Structure stability

PI: ERDC – Steve Hughes

SAJ – Jason Engle

# Aguadilla Harbor, Puerto Rico

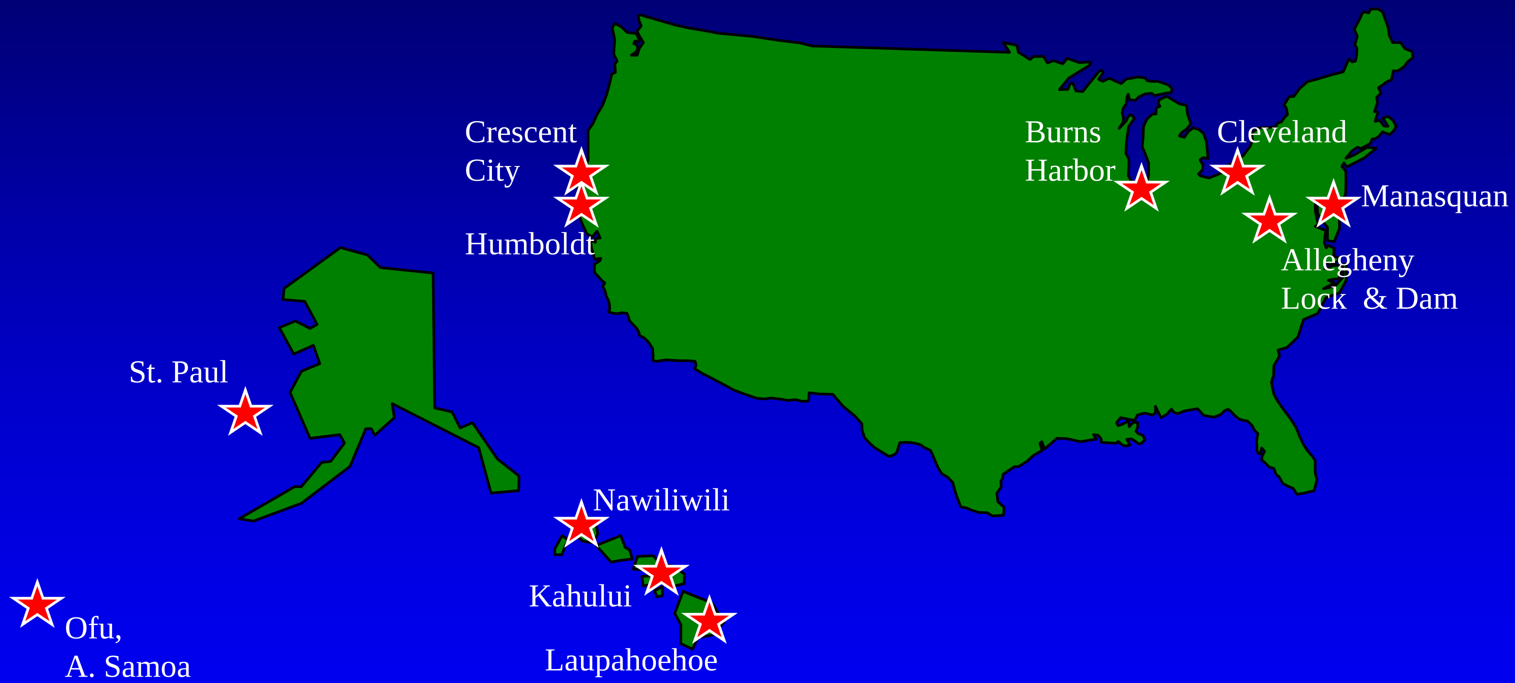


# Projects Continuing into FY05

1. Periodic Inspections (St. Paul Harbor, Alaska)
2. Upper Mississippi River Training Structures
3. Houston Ship Channel, TX
4. Pocket Wave Absorber, Great Lakes
5. Bendway Weirs, Greenville Bridge Reach, MS
6. Program Management and Technology Transfer

# MCNP Periodic Inspections

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# Periodic Inspections

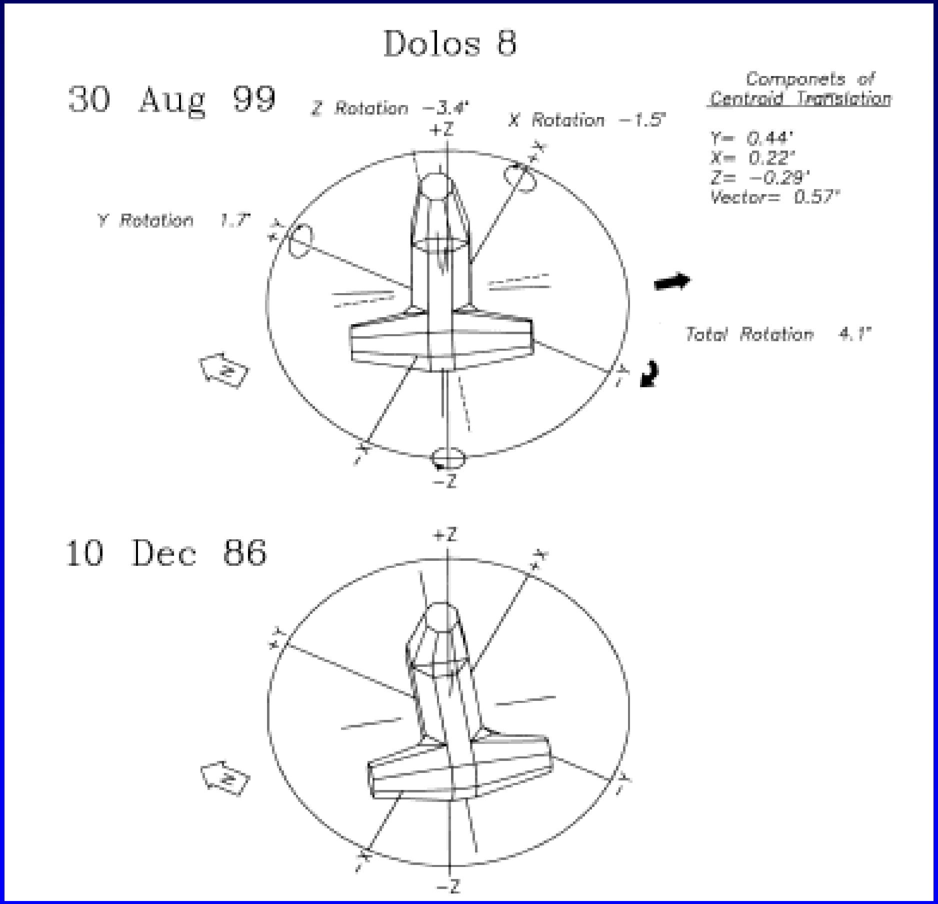
## Monitoring Study

Periodic low-level monitoring of coastal structures to determine their response to the environment over a period of years

Use relatively low-cost remote sensing technologies

PI: ERDC – Jeff Melby
POH – Dan Meyers
SPN – Lisa Romanoski

# Periodic Inspections

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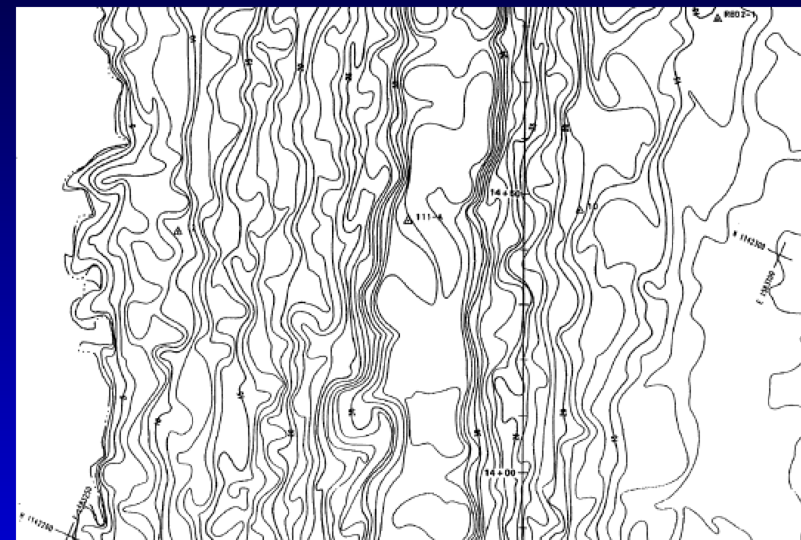
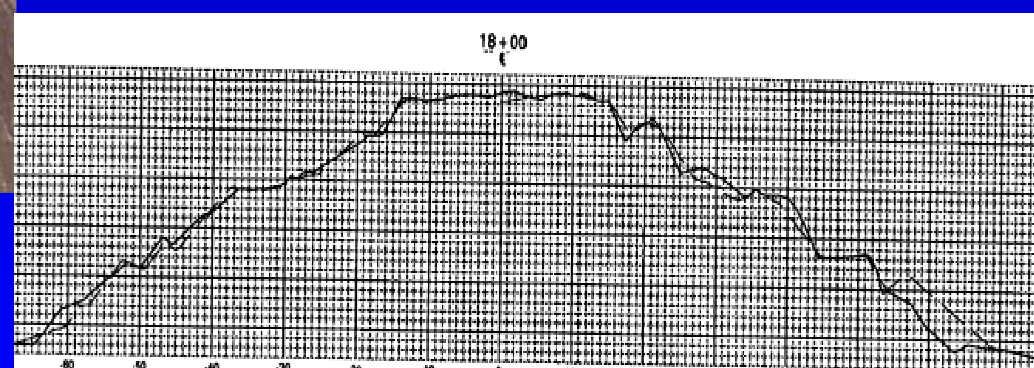
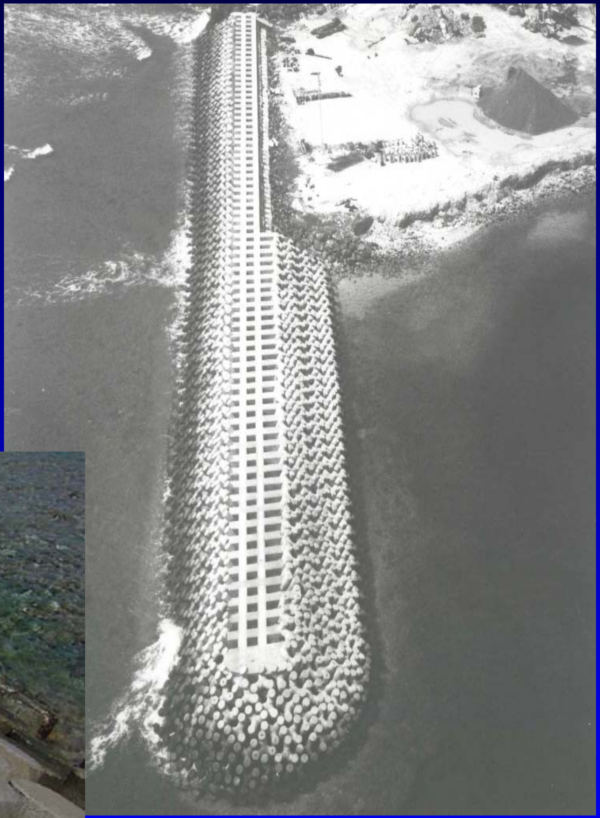
# Periodic Inspections





# Periodic Inspections



# Upper Mississippi River Training Structures

## Monitoring Study

Bathymetry

Velocity fields

Static velocity profiles

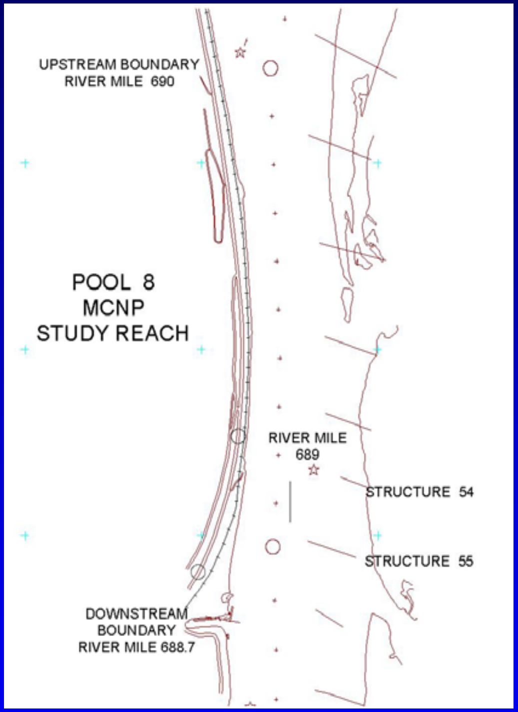
Suspended sediment samples

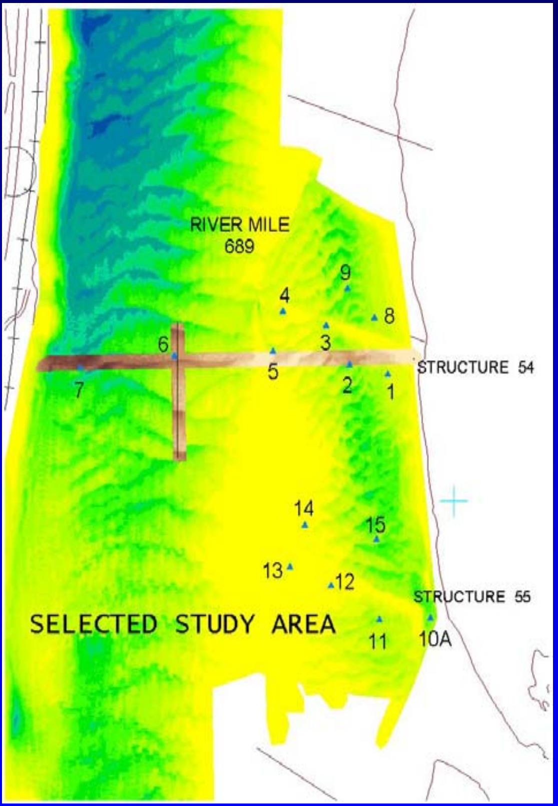
Bed load measurements

Bed material samples

PI: ERDC – David Abraham
MVP – Jon Hendrickson
MVR – Kevin Landwehr

# Upper Mississippi River Training Structures

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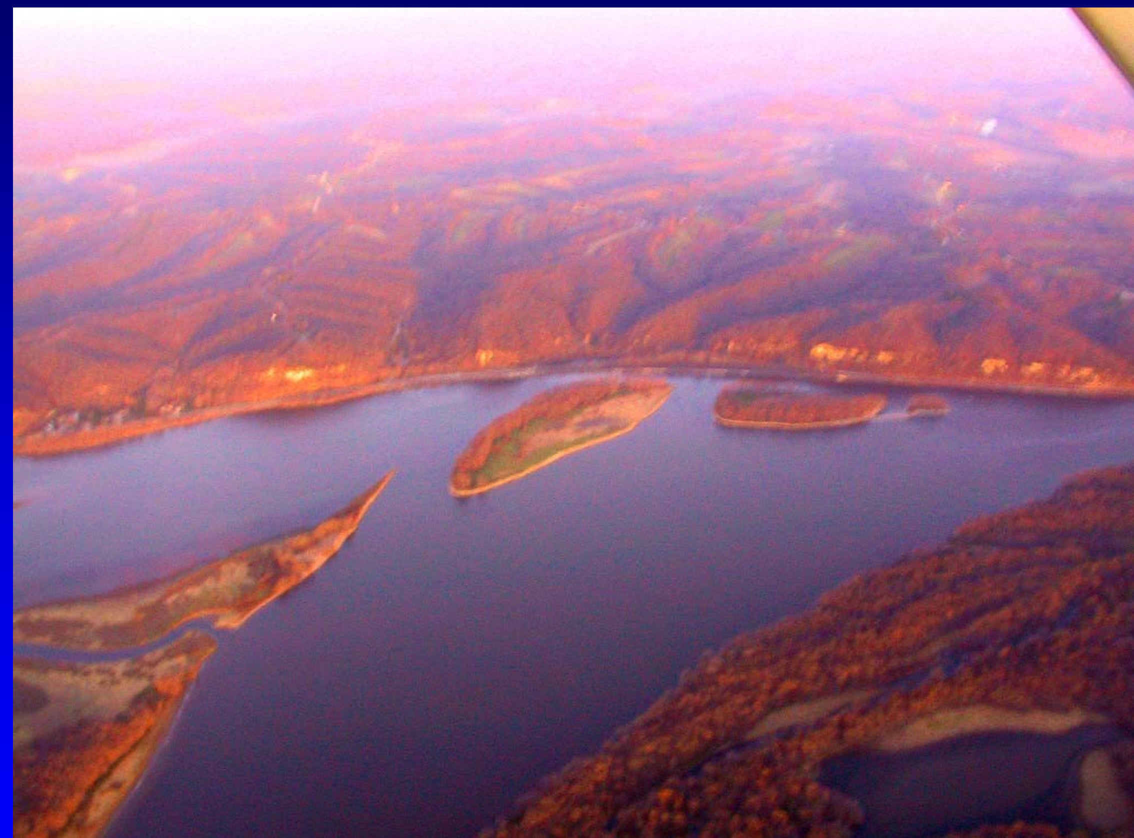
Coastal and Hydraulics Laboratory - ERDC

# Upper Mississippi River Training Structures



# Houston Ship Channel, TX

## Monitoring Study

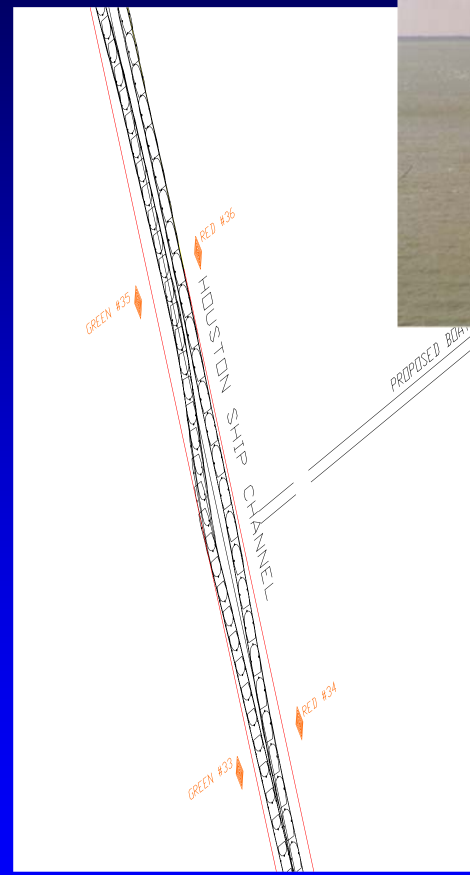
**Vessel Motions (DGPS-six degrees of freedom)**

**Numerical vessel models**

**Ship simulation model**

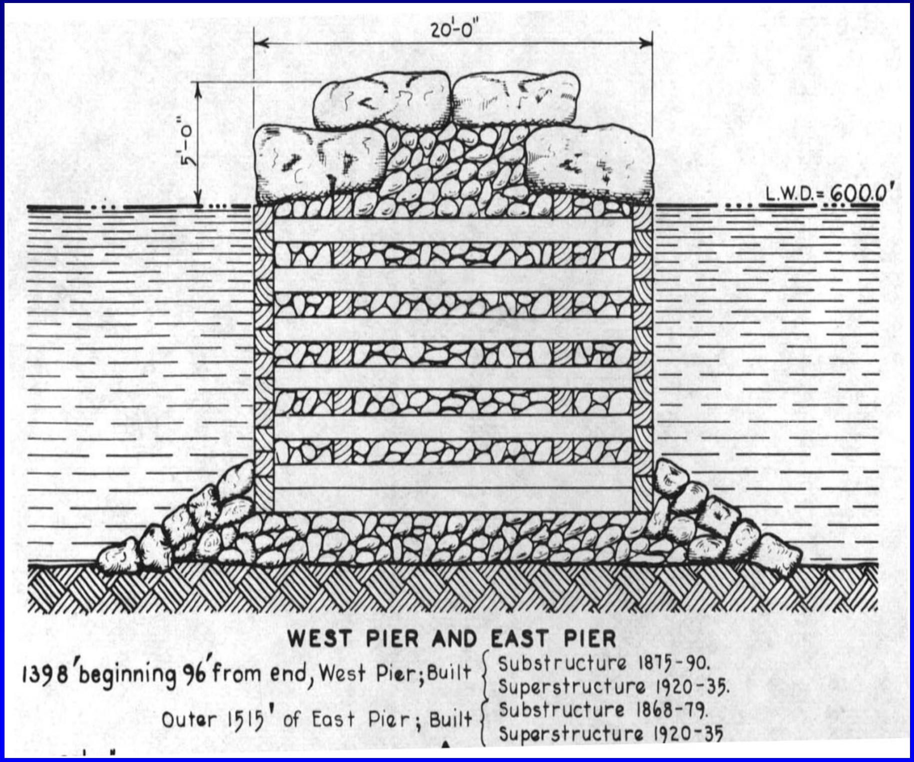
**Two-way vessel interaction**

**PI: ERDC – Dennis Webb**
**SWG – Alton Meyer**




# Houston Ship Channel, TX

# Pocket Wave Absorbers, Great Lakes


## <u>Monitoring Study</u>

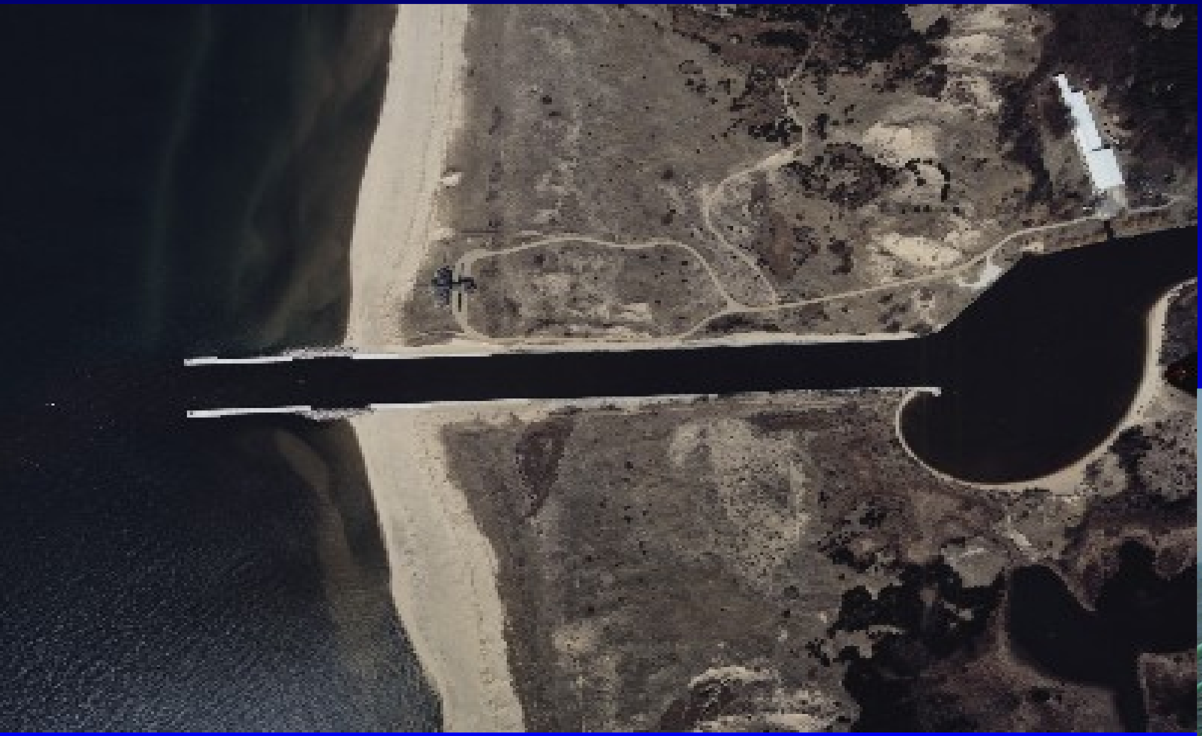
**Wave Data, Modeling**

**Design guidance**

**PI: ERDC – Ed Thompson**

**LRE – James Selegean**

# Pocket Wave Absorbers, Great Lakes



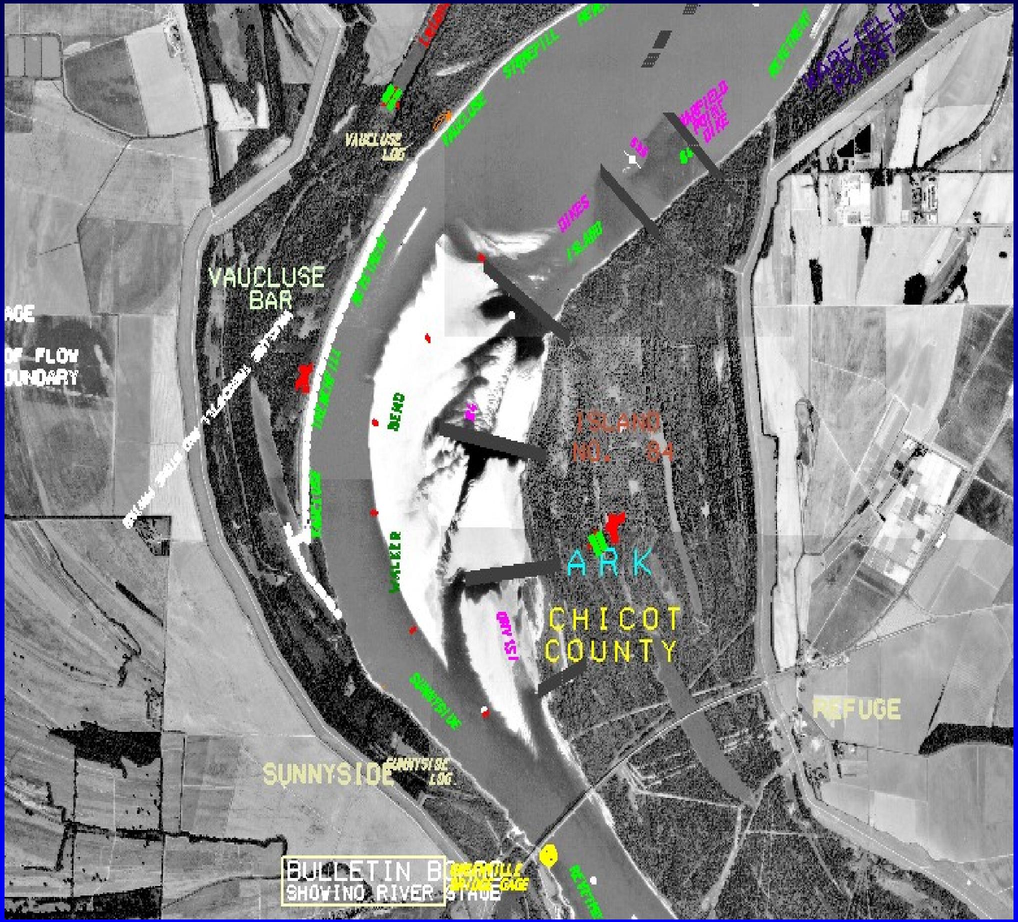
# Bendway Weirs, Greenville Bridge Reach, MS

## Monitoring Study

- Time lapse video (vessels)
- Bathymetric data
- Current data
- Tow track data

PI: ERDC – Howard Park

MVK – Glenda Hill



# Proposed FY05 New Projects

1. John Day Lock and Dam, Columbia River
2. Kaumalapau Harbor, Island of Lanai, Hawaii
3. Great Lakes Breakwater Armor Stone Testing Methodologies
4. Wall Armor System, John T. Myers Locks and Dam, Ohio River

# John Day Lock and Dam

**ERDC PI: Randy McCollum, CHL**

**Portland District Team Member: Kyle McCune**

## Problem

**Addition of (a) Spillway Flow Deflectors, and (b) Spill Pattern Generators, and changed operations to improve fish passage through the tailrace environment, and water quality, have adversely impacted the Dam's ability to safely meet it's navigation mission under certain river conditions.**

**Columbia River Towing Association (CRTA) has reported several instances of hazardous and unsafe navigation conditions. Apparently, navigation current conditions have been negatively impacted due to these modifications. CRTA has requested that the system modifications be investigated to eliminate the unsafe navigation situation existing here and at 7 other similar dams located on the Lower Columbia and Lower Snake Rivers.**

# Location Map, John Day Lock and Dam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# John Day Lock and Dam, Columbia River

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Coastal and Hydraulics Laboratory - ERDC

# Fish Passage Ladder, John Day Lock and Dam

# Tow Approaching John Day Lock from Downstream

# Existing ERDC Physical Model, John Day Lock and Dam

# Study Approach

The existing physical model predicts a significant volume of flow moving from the spillway toward the powerhouse, opposite in direction from what was measured by a limited 2003 Acoustic Doppler Current Profiler (ADCP) survey. This reverse entrainment in the model is believed to be directly related to underestimating the current velocities in the vicinity of the navigation lock approach.

Portland District is proposing to acquire a comprehensive data set under various flow conditions to understand the impact of flow deflectors and spillway operations on the trailrace environment adjacent to the navigation lock. Entails intense monitoring of the entrainment between spillway, flow deflectors, and powerhouse. Changed river bottom topography also will be acquired to determine impacts on currents.

Monitoring will establish impact of fish passage improvement, and create a data set for improvements to both physical and numerical modeling.

# Kaumalapau Harbor Breakwater

## Island of Lanai, Hawaii

### ERDC PI: Steve Hughes, CHL

### Honolulu District Team Members: Tom Smith and Jessica Hays

## Problem

The harbor, constructed in 1922, is the only deepwater port on the island, and services the hotel tourist industry and import of food and commercial goods. The breakwater has severely deteriorated over the years.

Because of the non-availability of large quarry stone, it is necessary to use manufactured armor units at this site (water depths 70 ft; wave heights 30 ft). 35-ton Core-Loc armor units (largest ever manufactured) will be installed (790 units). Will be placed over existing broken dolos armor units. It is significantly important to understand the design, stability, construction, and performance of these units.

# Location Map, Kaumalapau Harbor Breakwater


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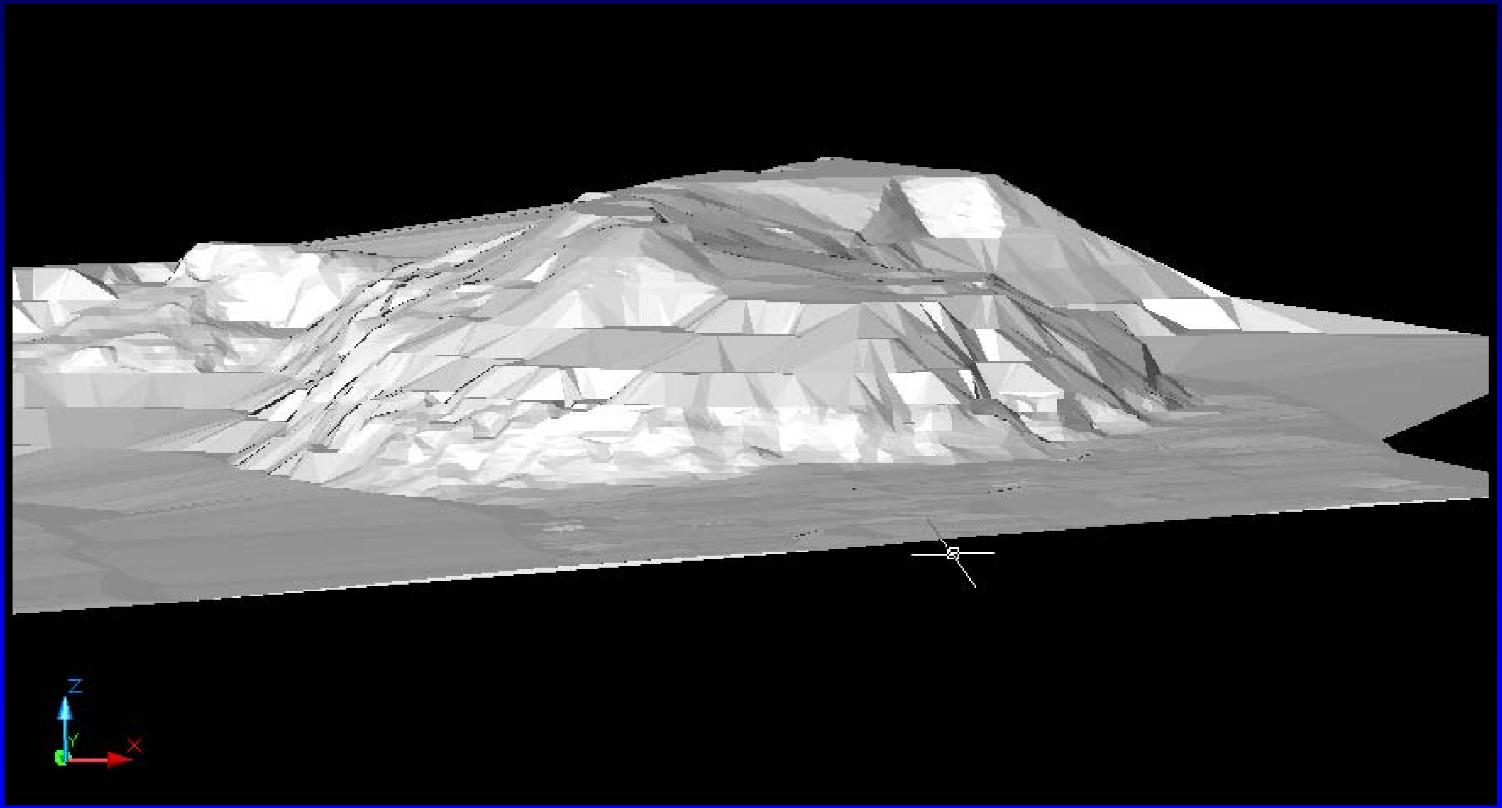
# Kaumalapau Harbor Breakwater

# Existing Underwater Section
# Kaumalapau Harbor Breakwater

# Digital Terrain Model
# Existing Kaumalapau Harbor Breakwater

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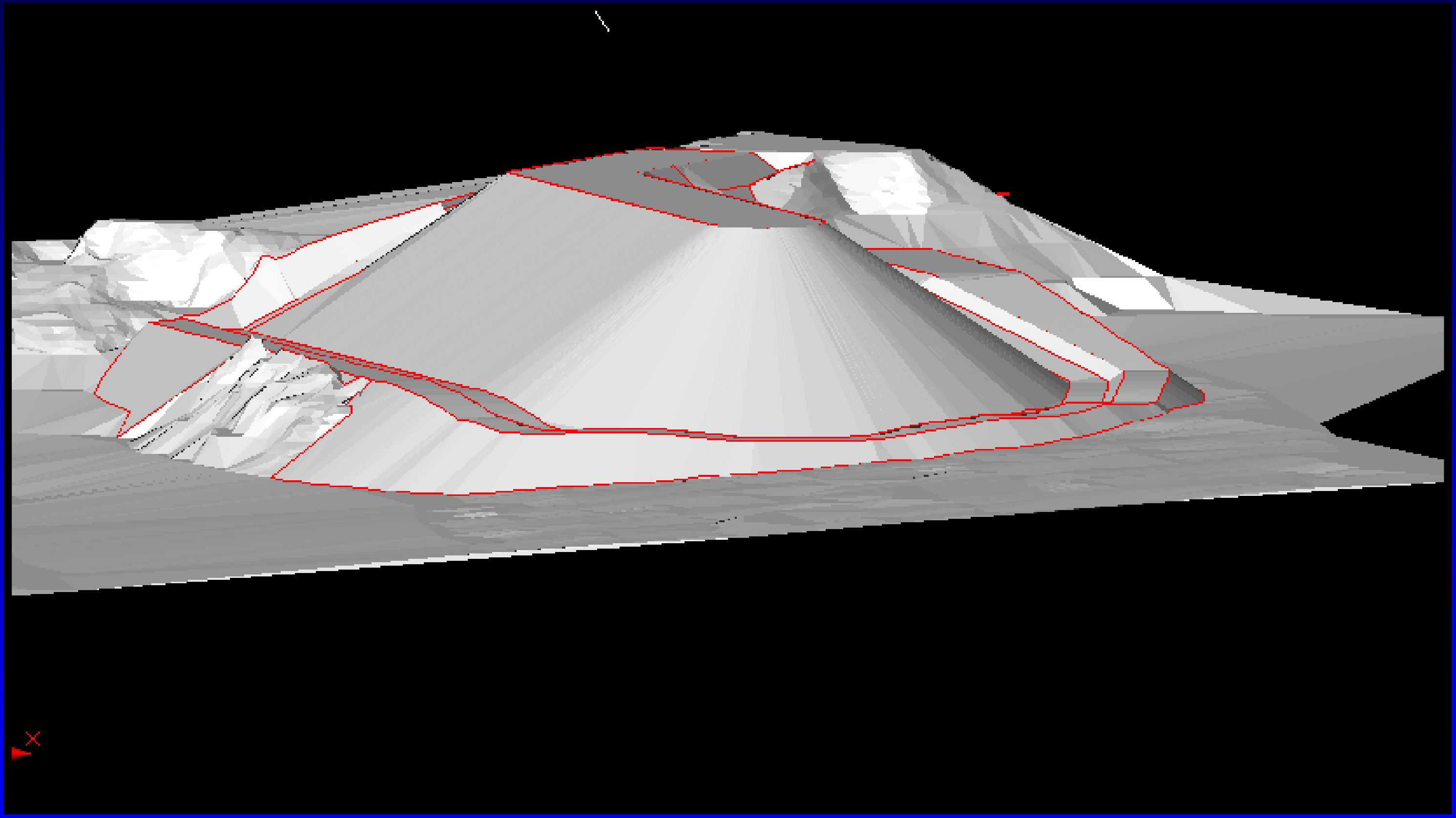
# Digital Terrain Model
# Rehabilitated Kaumalapau Harbor Breakwater



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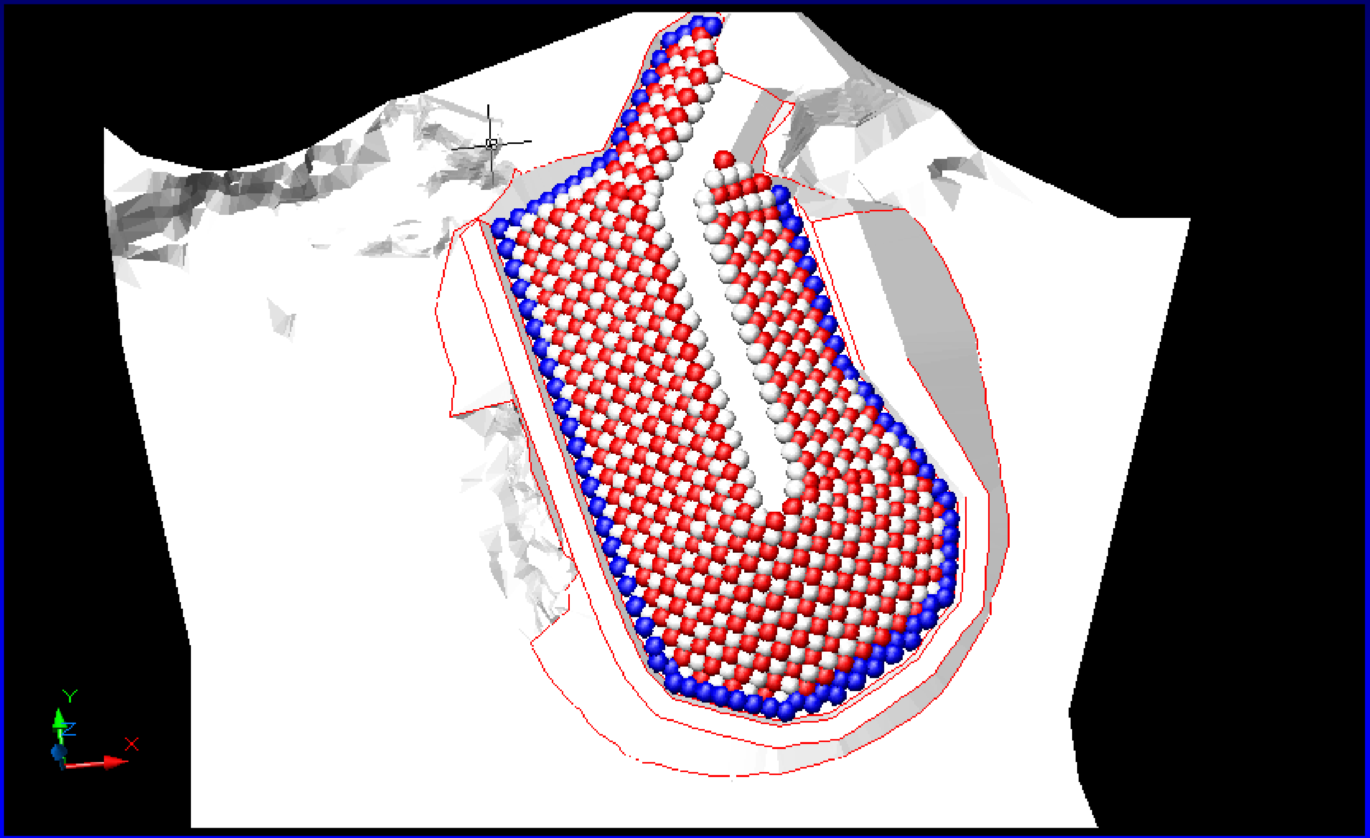
# 35-Ton Core-Loc for Rehabilitating Kaumalapau Harbor Breakwater

# Final Kaumalapau Harbor Breakwater Repair, Showing Location of Individual Core-Loc Units



# ERDC Physical Model Stability Tests
# Kaumalapau Harbor Breakwater

# Study Approach

**This breakwater repair provides a unique opportunity to monitor a project that incorporates the largest Core-Loc armor units ever utilized by USACE.**

**Objectives include detailed documentation and assessment of breakwater repair activities (underlayer preparation, armor unit fabrication, placement, etc.) for base line data, and subsequent monitoring and evaluation of project performance. Monitoring and quality control of the underlayer shaping will be essential to the overall success of the Core-Loc placement.**

**Specific Core-Loc units will be marked, photographed, and location surveyed by GPS. Weathering and weak zone within units will be tracked. The MCNP program will leverage resources with the District's Project Inspection Program. Sub-aerial precision armor unit monitoring will be conducted annually and following significant storm events.**

# Great Lakes Breakwater Armor Stone Testing Methodologies

**ERDC PI: Danny Harrelson, GSL**
**Chicago District Team Member: Joe Kissane**
**Detroit District Team Member: Ron Erickson**
**Buffalo District Team Member: Mike Felenz**

## Problem

**Specifications for armor stone for breakwaters and jetties include objective criteria from laboratory tests, and subjective criteria based on quarries and stockpiles. Issues related to stone durability and variability of quality between and within quarries are exceedingly problematic.**

**ASTM tests presently used were designed for small concrete aggregate and stone many orders of magnitude smaller than stone on breakwaters. These small-scale tests are not appropriate for stone weighing tens of tons.**

# Wire-Saw Cut Quarry Operation
# Reed Quarry, Bloomington, IN

# Drilled and Blasted Quarry Operation
# Valders Quarry, Valders, WI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# Drilled and Blasted Quarry Operation
# Dempsey Quarry, Waterloo, WI

# Thin-Bedded Carbonaceous Sandstone
# Johnson Quarry, Kipton, OH

# High-Energy Blasted Dolomite
# McCook Quarry, McCook, IL

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# Low-Energy Blasted Dolomite
# Valders Quarry, Valders, WI

# Separations at Dolomite Planar Weaknesses Even with QA/QC

# Limestone Blocks along Chicago Shoreline

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# Bedding Planes in Limestone Blocks along Chicago Shoreline

# Blasted Granite Armorstone - Note Absence of Discontinuities

# Study Approach

Objectives are to investigate and evaluate effects of scaling on lab test results using samples of various rock types used in Great Lakes coastal projects. Several different sizes of each different stone type from different quarries will be cut to the same relative dimensions. Some of these samples will be tested prior to any weathering exposure using existing protocols. Scaling effects will be ascertained.

Various size samples will be placed on prototype structures to experience weathering effects of wet/dry and freeze/thaw, and large wave attack. Results will be compared to prior lab tests.

Results will be used to develop guidance and new protocols for armor stone selection with respect to ranking of stone types, excavation methods, and geologic characteristics of material available in a region.

Quarry operators indicate test stone is available at minimal or no cost, including dolomite, limestone, granite, sandstone, and quartzite.

# Wall Armor System
# John T. Myers Locks and Dam, Ohio River

**ERDC PI: , GSL**

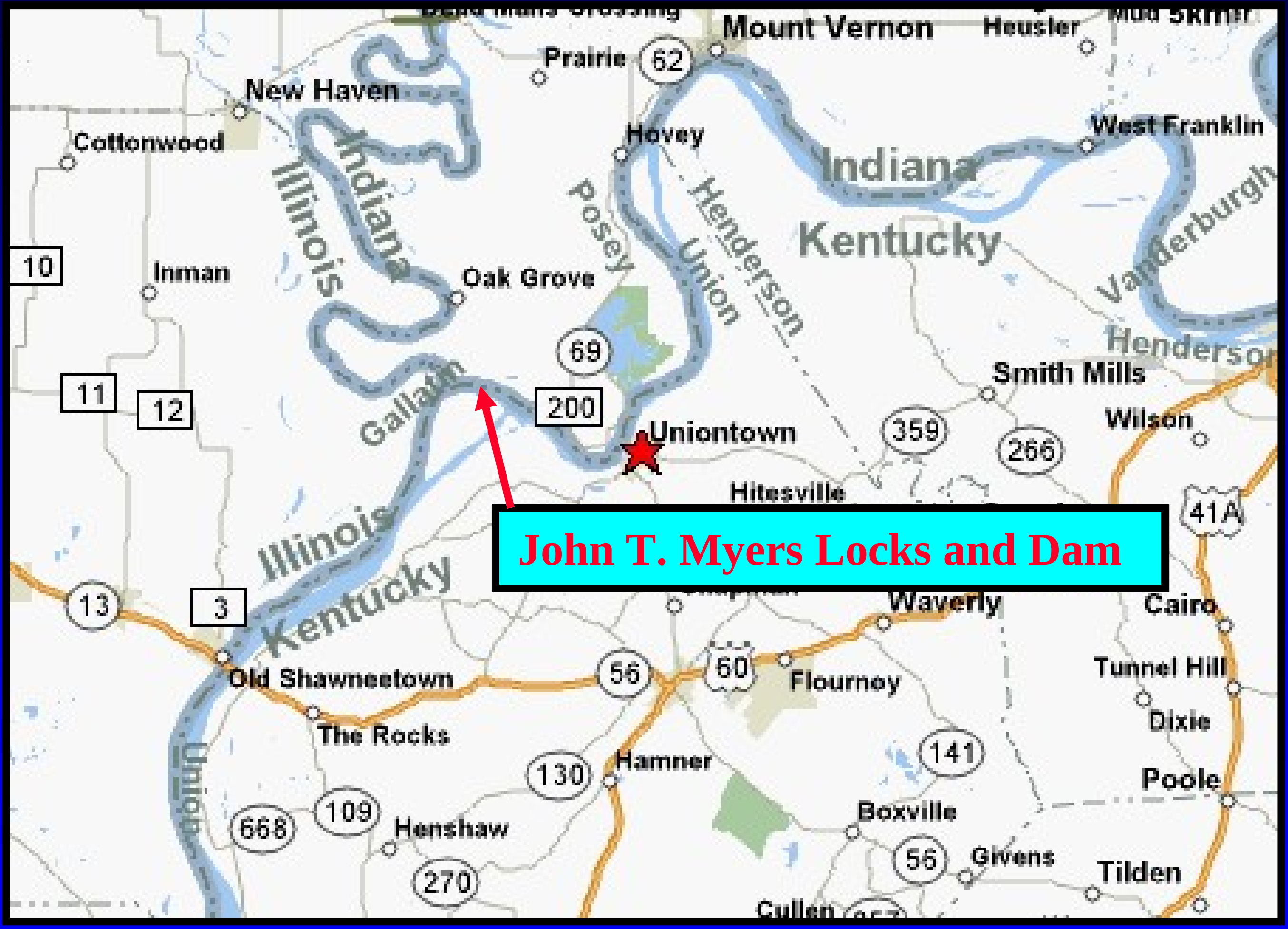
**Louisville District Team Member: Rick Lewis**

## <u>Problem</u>

**Lock wall armor system is experiencing a large amount of damage due to the large number of vessels passing through the locks. Majority of damage includes gouges and spalls in the concrete adjacent to armor strips. Many of the gouges are next to vertical joints. Several locations includes broken armor.**

**Majority of damage occurs in 1,200-ft lock, due to impact and abrasion by commercial barge traffic that typically use this lock. Broken wall armor is vulnerable to “catching” protruding metal on barges (a special concern for barges that have protection themselves). When armor is worn flat, it is no longer effecting in protecting the surrounding concrete.**

# Location Map, John T. Myers Locks and Dam

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# John T. Myers Locks and Dam, Ohio River

# Lock Entrance

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# Lock Wall Armor System

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# Wall Armor System Deterioration

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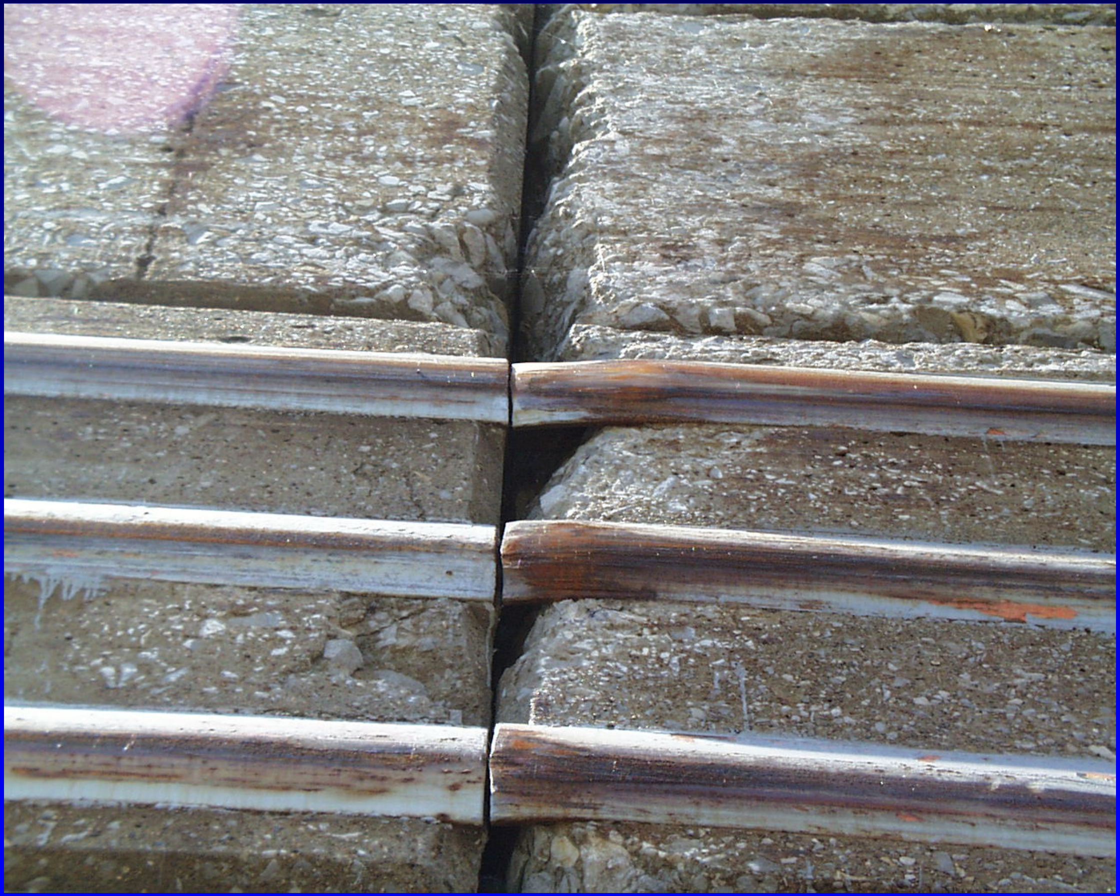

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# Wall Armor System Deterioration

# Wall Armor System Deterioration

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# Wall Armor System Deterioration

# Wall Armor System Deterioration

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# Wall Armor System Deterioration

# Existing ERDC Physical Model, John T. Myers Locks and Dam

# Study Approach

The design parameters for this lock were insufficient, resulting in extensive wear of the lock walls. Design did not provide for wall armor protection at the concrete joints, with considerable damage to the concrete and armor. Performance prediction technology was not fully utilized.

The ability of this lock to remain fully functional is significant to insure continued efficient operation of the system, a major artery for commercial navigation in the U.S. Innovative repair techniques must be applied to not disrupt navigation traffic through the locks and on the Ohio River.

Continuous monitoring should be undertaken to provide prediction indicators of the rate and extent of projected deterioration of the wall armor system. This will provide an indication of the amount of time available for development of non-disruptive repair methodology.

# Homepage - MCNP Web Site

MCNP

# Monitoring Completed Navigation Projects Program

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- Monitored Project Sites
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- Current Projects
- Technology Infusion
- Lessons Learned

## Program Description

The Monitoring Completed Navigation Projects (MCNP) program evaluates the performance of completed civil works navigation projects. Its objective is to obtain information for verifying or improving navigation project performance. Monitoring is conducted to (1) determine if the project is functioning as designed, (2) improve design procedures, (3) improve construction methods, and (4) improve operations and maintenance techniques.

For complete description in Adobe PDF format click here.

To get Adobe PDF Reader click here.

**Program Manager**

Robert Bottin

**HQ Program Monitors**

Barry Holliday
Dave Wingerd
Charles Chesnutt

What's New | MCNP Publications | Related MCNP Links

Coastal and Hydraulics Laboratory
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